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Sustainable development goals in mining

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ABSTRACT

In 2015, the United Nation (UN) launched 17 Sustainable Development Goals (SDG) as part of an Agenda to be achieved by 2030. The target is having a global plan of action, aiming at universal peace and social and environmental justice. For this, 169 goals were drawn. The objective of this research is to discuss the congruence between mining activity and the SDG, starting from experiences of the scientific literature and the observation of one mining activity. For this purpose, the Web of Science and Scopus databases were used, with the keywords "sustainable development goals" and "mining". The Coordination of Improvement of Higher Education Personnel (CAPES) Portal was used to search papers that relate each one of the SDG to mining. Visits were made to three crushed stone mining industries, located in Monsenhor Gil, Piauí, Brazil, in order to follow the production process of the diabase mineral. From the research in the literature, it was possible to verify that there are several possibilities of reaching the 17 SDG in the mining sector, such as in the promotion of jobs (SDG 8), contributing to the reduction of poverty (SDG 1) and hunger (SDG 2), among others. From the visits, it was observed that the compliance with SDG related to the promotion of jobs, the improvement of income for community's residents, and the infrastructure of the environment are common to all mining or business activities that reach remote and poor areas. This is clear when identifying mining regions that have lost their economic importance once the local development ceases. If the visited industries left the place, it would cause great loss to the residents that depend on them for their jobs. There is a small number of women on the staff, setting up disrespect for SDG 5 regarding the achievement of gender equality. The nature of the activity itself does not justify the asymmetry that possibly happened under the influence of a sexist culture that imposes what is a man's job or a woman's job. Another point is the lack of investment in inclusive education for employees and for residents of the region. In addition, these industries do not recover the degraded areas, compromising the achievement of SDG 13, in regard to combat climate change and its impacts.
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1. Introduction

In September 2015, the United Nations General Assembly approved a document entitled "Transforming our world: the 2030 Agenda for Sustainable Development" with the aim of drawing up a plan of action for people, the planet and posterity, aiming at strengthening universal peace through a global partnership. The Agenda presents 17 Sustainable Development Goals (SDG) and 169 targets, based on the eight Millennium Development Goals (MDG), launched in 2000, for the fight against poverty (United Nation - UN, 2015).

Based on the goals established by the MDG, the SDG were launched, containing guidelines for action on social inclusion, environmental sustainability, and economic development. In general, SDG is an extension of the MDG, and its fundamental objectives are to eradicate extreme poverty, combat inequality and injustice, and contain climate change (Programa das Nações Unidas para o Desenvolvimento – PNUD, 2017).

An essential feature of the 2030 Agenda is the recognition that social and economic development depends on sustainable management of the natural environment and its resources (Terama et al., 2016), which facilitates the implementation of SDG in any

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economic/industrial activity. Thus, the mining sector has a broad capacity to achieve these goals, through the mobilization of economic and technological resources. According to Florkowska and Bryt-Nitarska (2018), the Agenda creates possibilities for the implementation of a more cooperative and supportive way of production and social organization with the capacity to promote social and environmental justice.

In an evaluation of the interaction between global mega-trends and SDG, Okado and Quinelli (2016) point out two challenges: the lack of parameters for a sustainable development model and the lack of homogeneity between countries to promote initiatives to improve and strengthen global governance. Governments' commitment to enforcing laws relating to environmental studies (mandatory for mining activities) and meeting their requirements represents a promising path for the industry to contribute to the achievement of SDG in a global way (Pfeiffer et al., 2017).

Thus, this study aims to discuss the congruence between mining activity and the SDG, starting from experiences of the scientific literature and the observation of one mining activity. The research was based on visits to three crushed stone mining industries and scientific publications on environmental sustainability in mining. The results point out many possibilities of applying the SDG in the mining sector, as well as the practices that can make the activity environmentally, socially and economically sustainable.

2. Methodology

For the specific and exemplary knowledge of one type of mining activity, visits were made to three crushed stone mining industries, located in Monsenhor Gil, Piauí, Brazil, where the processes of extraction, processing, and commercialization of the diabase mineral were monitored. Also, the environmental studies imposed by Brazilian legislation, elaborated for the environmental and mineral license process, were accessed. During the visits, it was possible to know the environmental and social impacts of this activity and to identify measures of service to the SDG in this specific type of mining.

To complete a broader view of the relationship between mining activity in the world and the SDG a systematic research was carried out in the scientific literature with the purpose of retrieving the publications that relate the terms used for the elaboration of SDG and the mining activity. For this, the Web of Science and Scopus databases were accessed, using the keywords "sustainable development goals" and "mining". Also, the Coordination of Improvement of Higher Education Personnel (CAPES) Portal was used to search for papers that relate each one of the SDG and mining, since this Portal offers more comprehensive research because it contemplates several databases.

For the specific search on each goal, there were selected keywords according to the central theme of the SDG, as shown in Table 1. The search was done using the "advanced search" key and selecting the "subject" field. It was also used the "publication date" filter to retrieve recent publications.

In addition, it was used the documents "Mapping Mining to the Sustainable Empowered Lives. Resilient nations. Development Goals: An Atlas" (World Economic Forum, 2016) and the Portuguese version of it "Atlas: Mapeando os Objetivos de Desenvolvimento Sustentável na Mineração" (PNUD, 2017), which provides some complementary information not included in the original document. Both provide a technical overview of the relationship between SDG and mining.

3. Results and discussion

In the first part of the research, the Scopus database recovered 32 papers and the Web of Science database retrieved 17 results, which relate the SDG to the mining activity. In both databases, besides the scientific articles, conference articles, book chapters, and other kinds of materials were found. From the specific search by SDG for each keyword, the number of articles retrieved is indicated in Table 1.

Table 1
Number of articles found on the CAPES Portal for each SDG.

Goal	Keyword	Quantity
SDG 1	“mining” AND “poverty”	72
SDG 2	“ore mining” AND “agriculture”	15
	“mining site” AND “soil contamination”	3
	“mining site” AND “water contamination”	14
SDG 3	“mining” AND “welfare”	27
SDG 4	“ore mining” AND “education”	14
SDG 5	“ore mining” AND “women”	25
SDG 6	“mining” AND “sanitation”	32
SDG 7	“mining” AND “clean energy”	13
SDG 8	“ore mining” AND “employment”	24
SDG 9	“mining industry” AND “innovation”	19
SDG 10	“mining” AND “equality”	12
SDG 11	“mining” AND “local communities”	25
SDG 12	“ore mining” AND “sustainability”	16
	“mining” AND “circular economy”	12
SDG 13	“ore mining” AND “climate change”	16
	“mining” AND “carbon footprint”	5
SDG 14	“ore mining” AND “sea”	26
	“ore mining” AND “ocean”	43
SDG 15	“ore mining” AND “biodiversity”	50
SDG 16	“mining” AND “peace”	13
	“ore mining” AND “justice”	24
SDG 17	“mining” AND “sustainable development goals”	7

Source: Authors.

The justification for choosing these keywords is described, in detail, in the results of each one of the SDG. The aim is not to be exhaustive in the presentation of all the recovered scientific literature, but only to refer it to the discussion of each SDG. Some articles were chosen to highlight the confrontation of each SDG with the mining activity around the world, as described in the scientific literature. From the scientific publications and the direct observation of the three crushed stone industries' routine, it was possible to propose actions of service to each one of the SDG that composes the document released by the UN, entitled "Transforming our world: the 2030 Agenda for Sustainable Development".

Although crushed stone mining is less environmentally damaging, compared to other types of mining (gold, copper, coal, among others), since it does not cause soil and groundwater contamination, other impacts are common to the activity independently of the type of mineral, such as: deforestation, changes in the landscape, natural resources' depletion, air pollution, noise, among others (Saha and Padhy, 2011; Tabatabaei and Mohammadi, 2013; Monteiro et al., 2018). In addition to these impacts, Careddu and Siotto (2011) add vibration, vehicle traffic and fumes.

The SDG service contributes to the mitigation of negative environmental impacts caused by mining, promoting environmental sustainability. Furthermore, it can guarantee social inclusion and economic development, through the generation of jobs and income, helping to combat poverty, the main objective proposed by MDGs (UN, 2015; PNUD, 2017).

3.1. SDG 1: end poverty in all its forms everywhere

The keywords “mining” and “poverty” were chosen to establish the relationship between mining and the fight against poverty. The primary approach in the papers highlights the poverty in mining areas (Bhattacharyya and Resosudarmo, 2015; Broad and Cavanagh,

2015), neighborhood impacts (Lu and Lora-Wainwright, 2014), public policy (Canavesio, 2014), mining in indigenous areas (O'faircheallaigh, 2013), among others.

Mining areas are usually located in communities away from commercial centers since the activity depends on the availability of the mineral in nature, which leads the villages to form around industries (Carney and Gushulak, 2016). The activity generates jobs for the residents, moving a chain of suppliers to provide the industries, generating income for the population, thus contributing to the reduction of poverty.

In addition to the generation of direct and indirect jobs, another form of cooperation is through the payment of taxes, fees, and royalties (Takano et al., 2016). The government must invest the amounts raised in communities, improving the population's life quality through campaigns aiming at poverty eradication through the creation of opportunities inside and outside mining companies.

A study developed in Peru showed that mining districts have a higher average per capita consumption of goods and products and lower poverty rates than similar districts. It can be explained by the presence of more educated immigrants who are attracted to the activity in the mines and by the jobs offered to the community natives, both in industries and in services related to mining (Loayza and Rigolini, 2016). In contrast, one research in Ghana found that a household in a mining community is more likely to be poor compared to an identical household in a non-mining area (Assan and Muhammed, 2018).

As perceived in the visits made to the crushed stone mines the activity employs people from local communities in all sectors (administration, transportation, machine operation, cleaning, etc.). The companies themselves provide the training required by the positions enabling the surrounding residents to take over the functions. Additionally, the activity attracts several other small businesses to meet the industries' demands such as suppliers of spare parts, uniforms for employees, food, which improve local commerce, increasing the job offer.

However, the salaries offered in these industries do not always meet all the needs of the employee and his family. More than 60% of the employees work in general service positions, receiving a minimum wage, which in Brazil represents a value around R$ 954.00 (approximately, US $ 256.00). Although this remuneration allows the family to leave the extreme poverty line, it does not offer the possibility of social ascension. The positions of machine operators, drivers and managers have higher remuneration, due to the need for specialization for the function.

In the environmental studies, developed by the industries in order to obtain an environmental and mineral license, there are an emphasis on the generation of jobs as a justification for the implementation of the enterprise. However, in the visited industries, it was found that the forecast described in the reports does not correspond to reality. It shows the contradiction between the data on forecast and the reality, which can compromise the achievement of this SDG, regarding the availability of positions in these industries.

Thus, mining can contribute with resources for reducing poverty, promoting direct and indirect jobs, offering fair wages, prioritizing regional trade, increasing tax collection, generating funds for public coffers and, expanding strategies to combat poverty in all its dimensions. However, this is only the potential of mining activity and does not correspond to the investigated industries' local reality.

3.2. SDG 2: end hunger, achieve food security and improved nutrition and promote sustainable agriculture

The selected keywords to search the interaction between this goal and mining were: "ore mining" AND “agriculture”, "mining site" AND "soil contamination" and "mining site" AND "water contamination". The choice of these expressions allowed for broader coverage of the relationship between mining, sustainable agriculture, and soil and water contamination, linking the fight against hunger and the achievement of food security.

The primary approach of this research is: the existence of rural settlements in mining areas (Constantin et al., 2015), the impacts of metals/minerals use on agricultural processes (Strawn et al., 2012), soil contamination by heavy metals in limestone mines (Luna et al., 2016) and gold (Abraham et al., 2018), contamination of surface water (Lopes et al., 2016) and groundwater (Hao et al., 2016), among others. These impacts can cause damage to soil and water, compromising food security in the mine region.

To contribute to the promotion of sustainable agriculture, it is necessary to manage the exploitation properly, since there is a real risk of soil and water contamination, as happened in the rupture of the tailings dam in Mariana, Minas Gerais, Brazil (Brasil and Pires, 2017). In this sense, it is necessary continuous monitoring of water and soil through geochemical surveys, since the mining companies are responsible for ensuring the use of these resources without any risk to human or animal health (Brasil, 2001).

There are techniques applicable to the various types of mining that enable to control the contamination by mining processes, such as the use of microbial enzymes for the evaluation and monitoring of soil health, in response to pollution by heavy metals (Wahsha et al., 2017). Another technique that promotes the improvement of soil conditions to achieve this SDG is bioremediation, which consists in the removal of toxic metals from contaminated soils through the interaction of microorganisms with metals, combining two opposite biological activities: oxidants bacteria and sulfate-reducing microorganisms. Metal contaminants such as copper, cadmium, nickel, and others can be leached, and the effluents obtained in the process can become clean enough to be reused in the environment (Jerez, 2017).

Besides soil contamination, erosion processes cause impacts on land use. An example is a study developed in Vietnam in aggregate's mining, where the transportation of sediment from the soil caused morphological changes that led to an imbalance in the soil properties and variations in the river hydrology, affecting agricultural areas (Brunier et al., 2014). In Colombia, a research has shown that water in mining areas was contaminated due to the accumulation of sediments, with color, taste, and odor alteration, compromising its use in agriculture (Ubaque et al., 2014).

In Brazil, mining companies must mitigate the negative impacts on soil and water, as established in the environmental licensing process. Law 9,985 brings, in its art. 2, the obligation of recovering degraded areas and the restoration of an ecosystem, or a wild population, as close as possible to its original condition (Brasil, 2000). One of the recovery forms is the environmental compensation, which allows the restoration happened after the exhaustion of resources or even the replacement of a nearby area, in the same watershed, if the place where the exploitation occurs cannot be recovered.

The crushed stone industries have complied with the legal requirements of environmental licensing, and the managers show concern to comply with the determinations regarding the degraded areas' recovery. But the cost of environmental compensation is not accounted for in the product's value. This data is relevant, since environmental recovery is obligatory and should happen, as far as possible, concomitant with the exploration (Monteiro and Silva, 2018). Similar situations are recurrent elsewhere in Brazil and the world (Josa et al., 2012; Baumbach et al., 2013). It means that there is a real risk of getting an environmental liability that society will bear when mining activity is not economically viable anymore.

The activity can contribute with knowledge on how mining can affect areas where agriculture is developed elaborating programs to fight hunger, promoting the integration between agriculture and mining through partnerships of this sector with agribusiness. One of the practical ways to achieve this goal is the economic and technological support for the implementation of community gardens. Thus, industries contribute to population generating opportunities for alternative sources of income meeting food needs.

3.3. SDG 3: ensure healthy lives and promote well-being for all at all ages

The keywords chosen for this SDG were “mining” AND “welfare” to analyze how mining may be related to the society's well-being. The central theme addressed by these papers is the impact on the surrounding communities' life, in different countries, contexts, and realities. The aspects considered in the studies are the impacts on the environment (Luna et al., 2016), health (Cronjé et al., 2013), and society (Howard, 2014), in mining areas, as well as the comparison between small and large-scale mining (Akudugu et al., 2013).

The promotion of well-being for all is intrinsically linked to the mitigation of the negative impacts caused by the activity. Among the impacts that affect the neighboring communities’ welfare, it can be mentioned: ground vibration (Ozer et al., 2008); topography alteration (Armaghani et al., 2015); deforestation (Ubaque et al., 2014), changing the region microclimate (Luna et al., 2016); fauna scaping (Milisa et al., 2010); air pollution (Peng et al., 2016); noise pollution (Iramina et al., 2009).

Besides the discomfort caused to residents of the mine region, some impacts can hit the employees more directly. It is necessary to use Personal Protective Equipment (PPE) to ensure the physical integrity of workers. It must be performed rigorous inspection by managers on the use of PPE in order to guarantee protection against accidents and diseases resulting from work (Lira et al., 2012).

In the visited industries, it was possible to verify that the use of face masks suitable for the activity (covering the whole face or just mouth and nose) can guarantee the prevention of pulmonary diseases and ear protectors can avoid deafness. It is necessary that the companies comply with the legal requirement regarding periodic preventive exams (Brasil, 2009), to guarantee the protection of employees, regardless of the type of ore exploited. In the crushed stone miners, compliance with this obligation was verified, since all the employees have performed the periodic exams.

A study developed in Mongolia proposes the integration of health into Environmental Impact Assessment (EIA) projects to collaborate with this SDG (Pfeifer et al., 2017). Thus, it is the role of miners to promote disease-fighting campaigns through educational programs to the community that cover all ages. As noted in the crushed stone industries, even if the focus of educational programs is to inform the population about the activity, raising awareness about the risks and ways to avoid them, it is also possible to encourage preventive disease care and promote anti-drug campaigns.

Mining industries can contribute by supporting vaccination campaigns (for children and adults), combating drug use, preventing diseases such as AIDS, among others. In addition, they can to prevent occupational diseases related to the activity, integrating health in EIA projects, ensuring access to information, which can promote disease control and better living conditions for the population.

3.4. SDG 4: ensure inclusive and equitable quality education and promote lifelong learning opportunities for all

The keywords used for this SDG were "ore mining" AND “education”, with the aim of establishing the connection between mining activity and education at all levels. Few papers present the link between school education and mining areas, as found by Figueiredo and Piana (2016). However, some studies address this issue, including the focus on teaching materials used in public schools located in mining communities (Sullivan and Green, 2016).

The mining industries must promote training courses for their employees according to the function (Cardoso et al., 2017). Additionally, the miners can offer opportunities, through education, so that the workers are able to discover and develop different abilities (Triginelli and Cunha, 2013; Azevedo et al., 2016).

One way to contribute to this goal is promoting sponsorship through scholarships and undergraduate and postgraduate programs, not just to staff but community members, too. The establishment of partnerships between universities and technical colleges ensures the training of young people to enter the labor market. The development agencies, such as the National Council for Scientific and Technological Development (CNPq), provide scholarships to the industrial sector with a minimum counterpart of the industry. CNPq invests in the application of financial resources for the training of qualified personnel to implement research, development and innovation projects in companies (CNPq, 2018).

The visited industries are mechanized, and it is necessary to carry out training courses to operate the machines, which are promoted by the company itself. There are, in these industries, manual labor, which does not require any level of training, which is usually performed by people, most of the time, with low schooling. The employees who occupy these positions are only literate, which means they have a low level of study.

There is a small school for children in the community close to the visited industries, but it is far from the centers of higher education and technical training, which are in Teresina, the state capital. Thus, none of these industries has programs to promote the access of young people and adults to courses of higher and technical level, configuring the failure of these enterprises to contribute with this SDG. There are options such as distance courses that could be implemented in the community, with the help of miners, facilitating the access to higher education and technical courses by residents. Generally, the computing and internet access capabilities of these industries stay idle at night and can be carefully become available to the community.

Bud et al. (2018) defend the importance of training courses that involve mining activity such as mining engineering, metallurgy, topography, environmental science, geology, among others. In addition to offering internships for technical, undergraduate and graduate levels, the miners can support scientific research and dissemination of knowledge in the area.

Another way to promote education at all levels is providing support for the maintenance of children in school, to give extra teaching/pedagogical material, and to assist the community in maintaining and renovating school buildings. Industries can create ways to encourage the permanence of employees’ children in school, promoting awards, bonuses, and benefits for those with a constant presence and high school performance (good grades).

One of the difficulties with this goal is community involvement. According to the manager's report, there are education projects promoted by the crushed stone industries, aiming to inform about the activity, its risks and how society can be benefited from mining, but there is no interest in participation. Attempts have been made to put the projects into practice through lectures offered by the industries, but there was no adhesion of the surrounding residents. Thus, the first step towards achieving this goal is to prepare educational material appropriate to the community's language that arouses its interest. There was no attempt to develop a material about mining that formed and informed about the activity.

3.5. SDG 5: achieve gender equality and empower all women and girls

For the research on this SDG the keywords "ore mining" AND "women" were used. The articles with this approach deal with women's participation in mining (Helbert, 2018), as well as problems related to the health of women residing in these areas, such as intercurrences during pregnancy (Fort et al., 2015) and respiratory diseases due to exposure to different metals (Lu, 2012).

Mining activity seems to be still essentially male (Mwakumanya and Maghenda, 2016). Women work mostly in cleaning services. To contribute to this goal, it is necessary to promote female inclusion, guaranteeing fair wages to both genders and working conditions that allow greater access of women to the mining activity.

The numbers from the UK-based agency PwC-UK (2018) show that women hold only 5% of jobs in the top 500 mining companies in the world. The survey also pointed out the percentage of women in mining in some countries: South Africa (21.5%); Australia (11.97%); USA (7.34%); Hong Kong (6.02%); Canada (5.24%); and the United Kingdom (4.27%) (PwC-UK, 2018). In Brazil, women's participation in mining reaches 12% of the posts (Brasil Mineral, 2017).

Botha (2016) noted, in a study in South Africa, that the biggest challenges facing women in the mining industry are sexual abuse and harassment. The most common incidents are: whistling, using vulgar or derogatory language, showing body parts, physical contact, and even getting raped and exchanging sexual favors for promotion. Also, there are discrepancies between the salaries paid to men and women. Even in the same position, women receive lower wages than men.

In the visited industries, it was possible to perceive the presence of women in administrative, cleaning and kitchen positions, which represents approximately 3%–5% of the staff, evidencing a different reality from the Brazilian average (12%). There are no women operating machines and equipment, as well as in management positions. The most common claim of industry managers is that women can become pregnant, which generates the expense with the maternity leave and the need for replacement by another employee during that period, hence the preference for hiring men.

It was also mentioned that some positions require "physical force", as to put the product into the trucks with the aid of shovels, which, in the managers' opinion, the structure of the male body is necessary, since the women tend to be more fragile and cannot perform this kind of activity as efficiently. However, there is a possibility of female participation in managerial positions and even operating machines that do not require physical force, discharging the logic that women should only occupy roles as cleaning/cook/secretary.

Female inclusion in mining activities still seems far from reality. It is necessary to open this market for women, with just and equal opportunities, so that there can be a change in this situation. Helbert (2018) proposes the adoption of an ecofeminist ethic to help identifying alternatives to correct the uneven distribution of the risks and benefits of mining projects between men and women. Thus, combating discrimination and harassment, encouraging the participation of women in leadership positions, providing appropriate PPE to women's needs, and paying fair wages are some of the measures that must be taken by miners to ensure women's inclusion in mining.

3.6. SDG 6: ensure availability and sustainable management of water and sanitation for all

The keywords used for this SDG were "mining" and "sanitation". The main approach of the recovered articles is related to water toxicity and its various forms of contamination by metals during the mining processes (Hao et al., 2016) and after the mine closure (Lopes et al., 2016). Preventing contamination of surface and groundwater is an inherent challenge to mining activity. The constant monitoring of surrounding waters is fundamental to ensure the quality of water resources (Arhin et al., 2016).

Industries should support sanitation works by providing periodic reports on wastewater conditions, as well as assuming responsibility for the management of the river basin where the industry belongs (Brazil, 2001). Encouraging the use of alternative sources such as reusable and recycled water and reducing consumption are attitudes that can contribute to achieving this goal.

For the efficient management of water resources, it is necessary to involve the government through projects, policies, and actions aimed at maintaining the water balance in mining areas. Aligning political, economic and social interests related to water is one of the ways to promote sustainable management and sanitation for all. The participation of local communities in discussions to improve water management policies, technologies and control means is essential to achieve this goal (Sena et al., 2016).

Some places on the planet are more vulnerable than others to the availability of water. According to Sena et al. (2016), access to water with security and quality is still a challenge for the Brazilian semiarid region. Local rainfall patterns, soil types and social conditions should be considered in the preparation of technologies for the supply and storage of water for the population, since the drought in the region is recurrent and prolonged, as well as in other parts of the world, which requires more attention in mining regions.

In the visited industries, the water is collected from an artesian well, installed inside the company. One of the assumptions of environmental licensing is the requirement of granting the artesian well to obtain an operating permit. One of the industries does not have this concession, configuring the failure of both the industry, to comply with this requirement, and the environmental agency, that granted the license even without the presence of this document.

The use of water in the crushed stone mining activity is to supply the facilities (kitchen, bathrooms, workshop) and water sprinklers, installed in the conveyor belts, for the minimization of crushed dust (the particulate matter from the crushing process). Water consumption is an average of 20,000 L/day in these industries. In coal and iron ore mining, for example, it is necessary to use water during the mining process, requiring greater attention and care for consumption, and it must be used, preferably, reuse water (Liphadzi and Vermaak, 2017).

Crusher mining industries generally do not contaminate water resources, as in other types of mining (gold, diamond, etc.). However, the responsibility for monitoring water quality and sanitation support also rests with this type of industry since the crushed stone industries provide the inputs (aggregates) needed for sanitation and infrastructure works, contributing to the achievement of this goal.

3.7. SDG 7: ensure access to affordable, reliable, sustainable and modern energy for all

To search for papers that relate mining and energy, the keywords "mining" AND "clean energy" were used. The articles retrieved in this research address the various forms of energy utilization in the activity (Palamure, 2016), including the use of clean energy (Choi et al., 2016).

Miners must improve energy efficiency, reducing consumption as much as possible and improving the maintenance of energy infrastructure wherever they are instaled. The choice for renewable energy sources, such as solar, wind and geothermal energy systems,

are options that can reduce disruptions to the mine site and improve energy distribution to surrounding communities (World Economic Forum, 2016).

About atmospheric emissions from energy production, Brazil is a country with a low CO_2 emission index when compared to other countries. The Brazilian index in 2016 was 101.3 kg CO_2/MWh, while China had a CO_2 emissions index of 772.1 kg/MWh, the USA, 489.8 kg/MWh and the EU 366.2 kg/MWh. In addition, the share of renewable sources in the Brazilian energy matrix was 43.5%, being one of the highest indexes in the world (Brazil, 2017a).

There are, in the state of Piauí, 82 wind farms, with an installed capacity of 1,439 MW and nine photovoltaic projects, with an installed capacity of 270 MW. The wind incidence and the potential of solar irradiation put the Brazilian Northeast in a prominent position for the use of these types of energy source (Brazil, 2017b).

Among the crushed stone industries, two operate with electric power and one with diesel generators. The average monthly consumption of electricity for the operation of the industries is 36,000 kWh, and the use of diesel oil for the company that operates with a generator is 15,000 L, for a production of 20,000 m^3 of crushed stone. It was possible to observe that there are several interruptions in the electric power supply, which compromises the good functioning of the industry and causes equipment malfunctions. The energy demand for the operation of the equipment is high and requires alternatives that are efficient and that produce less environmental impacts.

One characteristic observed in these industries, which applies to other types of mining, is the different consumption of energy in the various stages of the process (Palamure, 2016). Each step requires an energy demand that must be evaluated when choosing the type of energy source to operate the industry, if there is a choice. The energy is necessary to perform the crushing equipment and the internal facilities (office, cafeteria, workshop). Other equipment, such as machinery (like excavators), are operated using fuels like diesel.

Palamure (2016) noted that large-scale mining operations are more energy-efficient compared to medium and small scales, requiring less energy to process a unit of ore. It suggests that there is a scale economy in iron ore mining operations, based on energy efficiency, that may be apply to other types of mining. Miners can take initiatives to generate clean energy where they are instaled. Levesque et al. (2014) discuss a new mine-specific benchmarking approach to demonstrate continuous improvement in energy efficiency in the mining industry.

The communication of energy issues must be transparent to have innovations in energy management, so that there is a parameter of comparison between the different operations to choose the most viable option for each specific case and, thus, share the benefits of this choice with society. Currently, there is a specific standard of the Brazilian Association of Technical Standards (ABNT) for energy management, based on ISO 500001: 2011 (ISO 500001, 2011).

3.8. SDG 8: promote sustained, inclusive and sustainable economic growth, full and productive employment and decent work for all

The keywords used for this SDG were "ore mining" AND “employment”, to verify the approach of the generation of jobs in the mining activity. The articles retrieved deal with subjects such as a career in mining (Torpey, 2013), women's participation in the activity (Kotsadam and Tolonen, 2016) and child labor (Maconachie and Hilson, 2016).

The mining activity generates a chain of jobs and income to the industries' surrounding residents. For the operation of the business, it is necessary may supplies, such as office provision, cleaning materials, food, uniforms, PPE, fuel, spare parts and maintenance for equipment, machinery and fleet, among others (Huang et al., 2017). Industries should, as far as possible, to acquire these items in the local market, bringing income to the region. Also, they should promote access to full and productive employment, providing training to employees, ensuring equitable inclusion, and collaborating with the child labor eradication.

As verified in the visits, one of the justifications for the project installation is the generation of jobs. In the environmental licensing processes of these industries, this argument permeates discussions about the viability of the project. However, there is disagreement between the number of employees envisaged in the environmental studies and reality. In one of the industries, the amount is less than the real, while in another, the number is higher. This inconsistency in the reports is relevant because job creation is a factor that makes viable the implementation of a mining project (Monteiro and Silva, 2018).

There is a chain of jobs generated by these industries. When they came to the region, there was an increase in the offer of work, both in the companies themselves and in other commercial establishments that were installed in the city, to meet the new demand. In addition to the supply stores, it was installed a lightning pole industry, due to the easier access to the crushed stone, an input used for the manufacture of poles. This reality can be applied to other types of mining in other parts of the world (Torpey, 2013; Huang et al., 2017).

The payment of fair wages and good working conditions are decisive factors in achieving this SDG. In the visited industries it has been found good working conditions, including the provision of PPE to protect against accidents and to avoid diseases caused by the activity. One of the industries has a large leisure area for employees and their families, with natural pool. However, the salaries paid are low, although according to the established by the Syndicate that rules the activity (Sindicato da Indústria da Construção Civil – SINDUSCON).

Some situations must be tackled in a joint effort among industry, government, and society, such as child labor in mining (Maconachie and Hilson, 2016) and unworthy conditions for women (Botha, 2016). Thus, miners play an essential role in promoting jobs for mine-dwellers, if they support decent working conditions, fair wages, combating gender discrimination and child labor.

3.9. SDG 9: build resilient infrastructure, promote inclusive and sustainable industrialization and foster innovation

To verify how the mining industry may be inserted in an innovation context, the keywords "mining industry" AND “innovation” were used. The papers address different technologies used in mining (Shi, 2015), customer relationship (Biggemann et al., 2013) and suppliers (Bravo-Ortega and Muñoz, 2018), as well as the relationship between innovation and sustainability in the mineral sector (Rosa et al., 2014).

The mining industries demand scientific research since the activity requires specialized techniques in various areas such as geology, mine engineering, among others. The innovation in the equipment, management, and techniques, improve the productive processes of these industries and represent an opportunity for the mining companies to contribute to this goal. Singh (2017) states that the development of research and innovation in mining can ensure that mineral resources are converted into economically mineralized reserves with safety and minimal impact on the environment and increase productivity.

Regarding the infrastructure, mining companies can contribute by sharing and expanding access to essential services such as sanitation works, road construction, railways, bridges, housing,

among others (Monteiro et al., 2018). Besides, they should encourage the acquisition of local goods and services, ensuring inclusive industrialization and integration with local commerce. It could be seen in the visits to the crushed stone mines that the roads were paved by the industries, improving the infrastructure of the region.

Collaboration among government, society, industry, academia, and stakeholders to support policies to contribute with innovations in mining is one of the ways to achieve this goal (World Economic Forum, 2016). It is necessary to improve scientific research to implement technological innovations in order to build more resilient infrastructures and to improve the industrialization process. Innovation can advance competitiveness in the sector since it promotes the creation of new products and processes aiming at minimal impacts on the environment (Rosa et al., 2014).

Another way to encourage innovation is using Industry 4.0 technologies such as Internet of Things (sensors, barcode, smartphones), Cyber-physical Systems (controllers and sensor systems), Cloud Manufacturing (internet, virtual commerce) and Additive Manufacturing (3D printers). Advances in digital manufacturing technologies contribute to decision-making, based on sustainable management of operations in industries (Jabbour et al., 2018). An example of the application of this technology in mining is the use of robots in caves and risk areas as well as in laboratory tests, explosives handling and equipment assembly (Cota et al., 2017).

One of the barriers regarding infrastructure in the mining industry is transportation logistics. In the visited industries, it was noticed that the mines should be located near the consumer centers, because the distance makes the trade of this mineral unfeasible, once it is a product of low value. This situation is also observed for other types of mining (Heider, 2013). Therefore, investment in infrastructure to improve the transportation of products, such as the construction of roads, railways, ports, is a benefit that extends to the community. In that sense, government collaboration is critical to incentive the implementation of the necessary improvements that society can enjoy.

3.10. SDG 10: reduce inequality within and among countries

The keywords used in the research on how mining can contribute to reducing inequalities were “mining” AND “equality”. The main approach of the papers is the impact of mining on poverty (Loayza and Rigolini, 2016), gender equality (Johansson and Ringblom, 2017), and environmental justice (Velicu and Kaika, 2017).

Mining industries can contribute to this goal by employing people from surrounding communities paying fair wages and reducing local wage disparities. The creation of policies to reduce inequality is the role of any industry, including mining, as well as the promotion of social inclusion through direct employment, and the collaboration with the government to expand access to infrastructure services for all.

To effectively collaborate in reducing inequalities, mining companies must anticipate risks by identifying the local population dynamics, before and after the industry's installation (World Economic Forum, 2016). Some of the possible attitudes to achieve this goal are promoting the recruitment and training of the marginalized population, working in partnership with local entrepreneurs and encouraging the allocation of resources, from mining, to ensure investments for the society.

Some mining companies are in indigenous areas. The industries must include traditional communities in their activities since these peoples can contribute with knowledge and habits, which must be valued and respected (Rocha et al., 2015). A study carried out in Australia has shown that public pressure and the benefits from the local Aboriginal people have boosted the implementation of indigenous vocational education programs, increasing the capacity and job supply for these people in the mining industry (Pearson and Daff, 2013).

To reduce inequalities between countries, miners can draw up cooperation plans, mainly between neighboring countries. Industries in border areas should promote equality and share infrastructure where they are installed. For example, Oliveira and Espíndola (2015) suggest that the Southern Common Market (MERCOSUR) countries need a greater harmonization regarding environmental legislation since they are border countries with common biomes.

One of the ways to assess the feasibility of implementing a mining industry is through consideration of scenarios with or without the company. In the Brazilian environmental licensing processes, this analysis is part of the consideration of whether, or not, to grant an environmental license (Brasil, 2001). Thus, the projection of different scenarios can help in the identification of strategies to reduce inequalities within and between countries, contributing to achieve this SDG.

3.11. SDG 11: make cities and human settlements inclusive, safe, resilient and sustainable

To establish the connection between SDG 11 and mining, the keywords “mining” AND "local communities" were used. The main issues addressed by these papers are related to environmental laws, growth, development and social/environmental sustainability of local communities (Kai et al., 2015; Lima et al., 2016; Katz and Pietrobelli, 2018).

The impacts arising from the cities and communities’ growth have caused several environmental and social consequences such as increasing of violence, poverty, and inequalities, reduction of green areas and fauna, pollution of rivers, among others (Pasternak, 2016), which can be applied to mine areas. The challenge of urbanization is to develop cities in an environmentally and socially sustainable way.

Mining companies can contribute by promoting the development of strategies for creating resilient urban areas, involving industries, government and community in planning land use, by implementing conservation plans for cultural heritage and restoring green spaces. One measure to contribute to reducing environmental impacts, generating opportunities for social inclusion and improving the conditions of the urban environment is promoting the recycling and reuse of mining waste.

It is necessary to consider the activity under four prisms, to balance the different dimensions of sustainability in mining: the framework and functionality of environmental regulation to protect the environment (environmental sustainability); competitiveness of the mining industry regarding environmental regulations and their application (economic sustainability); public participation and the opportunities for local communities to influence their environment, as well as the acceptance of projects by communities before and during operations (social sustainability); and the protection of cultural rights in mining projects (cultural sustainability) (Kay et al., 2015).

Another way to achieve this goal is recovering degraded areas. Brazilian law requires the recovering of the environment, by mining companies, during and after exploration (Brasil, 1997). Meeting this legal principle can make the environment around the industries healthier. In the visits to the crushed stone companies, it was possible to notice that these industries do not recover the degraded areas. The common claim is that it is not possible to recover an area that is in full operation, which makes the process impracticable.

When there is no possibility of rehabilitating the area that is still being exploited, the miners can promote the recovery of a nearby site, in the same watershed, ensuring compensation for mineral exploration (Monteiro and Silva, 2018). Thus, industries have the role of promoting healthy environments, both inside and outside the place where they are instaled, to contribute to the achievement of this goal.

The installation of mining activity affects the surroundings and nearby towns. After the mine is depleted, an economic crisis in the region can occur. Therefore, it is part of the socio-environmental responsibility of the mining companies to expand the possibilities of assistance to the population after the end of their activities.

3.12. SDG 12: ensure sustainable consumption and production patterns

The combinations of the keywords "ore mining" AND “sustainability” and “mining” AND "circular economy" were used to search for papers relating mining to sustainable production and consumption. The primary approach of the articles is about the possibility of recovery, recycling, and reuse waste in the different types of mining's productive chain, aiming at becoming the activity more sustainable (Schoenberger, 2016; Lebre et al., 2017; Schneider et al., 2017).

Mining industries must improve waste management through recycling and reuse techniques to achieve sustainable production and consumption patterns. In Brazil, Law 12,305/2010, determines the destination of materials that cannot be reused in any way. The city hall must collect them or they must be deposited in the appropriate places by the generator itself, as the case of industrial waste (Brasil, 2010). The other wastes generated by these industries can be somehow reused, based, for example, on the circular economy principles.

The incorporation of the circular economy concept, based on the principle of waste reuse within a productive chain, generating economic, social and environmental gains, can help to change the patterns of production and consumption, to make the mining activities environmentally sustainable, socially just and economically viable.

The circular economy presents new opportunities, stimulating management practices and creating value to organizations in harmony with the environment (Leitão, 2015). Thus, the practice of an economy closer to the circular can contribute to sustainable development, since there is a reduction of waste, an increase in income, through improvement in the productive processes' management, reflecting in the enhancement of population's life quality.

Regarding mining activity, proactive and preventive waste management provides environmental benefits, generating value from the material that would be discarded from the mines (Lebre et al., 2017). Therefore, the principles of the circular economy, referring to the optimization and improvement of the natural capital use, can be applied in a practical way to a mining operation, contributing to achieving this goal.

The visited mining companies, as well as any other type of mining industry, in partnership with the government, can promote campaigns to the community for the teaching of practical actions on domestic waste recycling, for their reuse and even for commercialization. In this way, they can contribute to raising awareness about the importance of adopting attitudes to avoid waste, promoting the reuse of materials, making the production and consumption patterns more sustainable from an economic and environmental point of view.

3.13. SDG 13: take urgent action to combat climate change and its impacts

The keywords chosen for this SDG were "ore mining" AND "climate change" and “mining” AND "carbon footprint" to understand how mining can contribute to the impacts of climate change. The papers discuss how mining activity affects climate change due to deforestation and atmospheric emissions (Ubaque et al., 2014; Aleke and Nhamo, 2016). Mining companies must potentially reduce their carbon footprint to help fighting climate change.

Silva et al. (2016) state that socially and economically vulnerable population groups suffer more from climate change, just like populations living in mining regions. It is essential to know the different realities and needs to connect them to a wider range of solutions for a solidary and peaceful survival. In this sense, education and population awareness is an important tool to achieve this SDG, mainly due to the adaptation and construction of resilience regarding major changes.

As observed in the visits to the crushed stone mines, it is necessary to clear the area where the exploration is done, suppressing the vegetation for the crusher and the facilities installation and for the ore extraction. In addition to the effects on the region's climate change, the impact of deforestation causes changes in the landscape and the scarcity of fauna, especially birds. However, the most evident consequence is the modification in the microclimate, which is felt by the surroundings inhabitants. This reality can also be applied to other types of mining, such as iron ore (Ranjan, 2018).

Miners can contribute by planning investments, designing risks and creating opportunities to reduce the climate change's impacts, especially by monitoring the minefield on variations in the region's microclimate. They must disseminate transparent reports that can help decision-makers to take measures to control this impact. Furthermore, it is necessary engagement between industry, government, and stakeholders to align corporate strategies to fight climate change globally.

3.14. SDG 14: conserve and sustainably use the oceans, seas and marine resources for sustainable development

For the research on how mining can impact the marine resources, the keywords used were "ore mining" AND “sea” and "ore mining" AND “ocean”. The results have shown that mining causes several impacts on the oceans, seas, and rivers, such as deep-sea mining (Santos et al., 2018), deposition of wastes and tailings (Ma et al., 2017) impacts on the riverside population (Brazil and Pires, 2017), among others. Mining companies should contribute to the sustainability of oceans and rivers by mitigating the impacts caused by the activity, in this context.

It is necessary to understand the dependence of local communities on the use of marine and coastal resources, assisting them in the management of the fishing activity to meet this goal (SILVA et al., 2013). The protection of aquatic ecosystems ensures the maintenance of the population's livelihoods in these places.

Investments in deep-sea mining have grown due to the scarcity of resources, in some regions of the planet. New technologies have been developed to improve offshore extraction techniques. This type of exploration entails impacts such as the transport of toxic sediments that can affect the marine ecosystems’ balance. In addition, it is a type of mining that requires higher investments in equipment and technology (Santos et al., 2018).

To contribute to this SDG, miners need to carefully assess the impacts of deep-sea exploration, collaborating with the government to create areas for protection and conservation of marine reserves, contributing to scientific research and innovation through the advance of management plans of coastal areas with

government and local communities. They should also collaborate with the development of the fishing activity in a sustainable way, respecting the closed period[1] and disposing properly waste and tailings.

3.15. SDG 15: protect, restore and promote sustainable use of terrestrial ecosystems, sustainably manage forest, combat desertification, and halt and reverse land degradation and halt biodiversity loss

The keywords used for this SDG were "ore mining" AND "biodiversity". The papers retrieved in this research address the various mining impacts on biodiversity (Tabatabaei and Mohammadi, 2013; Villarroya et al., 2014; Ritter et al., 2017; Monteiro et al., 2018). Mining industries can achieve this goal by reducing the negative impacts through environmental compensation measures. Although it is not possible to recover an area that is in full activity, there are ways to recoup for the exploitation, recovering other areas, near or far from the mines (Brasil, 2001).

In Brazil, miners must pay a monthly fee, the Financial Compensation for the Exploration of Mineral Resources (CFEM), as part of the environmental cost for exploitation of nonrenewable natural resources, which is calculated on the value of net revenue and it is different for each type of mining. The funds collected with CFEM are applied to projects that directly or indirectly benefit the local community (DNPM, 2004). Many countries admit the use of compensation. However, not all require their implementation, as in Brazil (Villarroya et al., 2014).

Mining industries must take compensatory measures to restore degraded environments and mitigate the loss of biodiversity. The activity's monitoring is a way of guaranteeing the conservation of the exploited environment, for future re-compositing and conservation of ecosystem services. This monitoring should be done by industries, by the community, and by government agencies (Brasil, 2001; Jaskoski, 2014).

The community participates in this process, accompanying and denouncing the activity that is outside the standards established by law. For this, it is necessary to inform and educate the population about the mining, so they can help the public power in the monitoring. A study in Peru has shown that popular participation in extraction areas has been essential in approving or rejecting mining projects. Community involvement, through public hearings, has a significant impact on government decisions, resulting in the suspension or cancellation of projects, in some cases (Jaskoski, 2014).

In the visits made to the crushed stone industries, it became evident that the environmental agency does not fulfill the inspection role since it does not carry out periodic inspections in these companies. Only one of them received an inspection due to the community's complaint about the accumulation of solid waste on the road nearby the industry, thus confirming the importance of society's participation.

Another peculiarity of the crushed stone industries is the emission of particulate matter, which accumulates in the surrounding vegetation. This accumulation of powder can cause changes in the vegetation morphology, altering the natural landscape (Tabatabaei and Mohammadi, 2013). This impact can be minimized using water sprinklers in conveyor belts, which reduce the incidence of particulate matter, conserving the original vegetation (Monteiro et al., 2018).

In addition to environmental compensation and monitoring, miners can contribute to this SDG by articulating actions with the government to create campaigns to combat desertification, instructing local communities on the environment and biodiversity's conservation, avoiding unnecessary deforestation and protecting areas where they are installed.

3.16. SDG 16: promote peaceful and inclusive societies for sustainable development, provide access to justice for all and build effective, accountable and inclusive institutions at all levels

To relate mining to the search for peace and justice, the keywords "mining" AND "peace" and "ore mining" AND "justice" were used. The recovered papers address conflicts in mining regions (Ortiz-Riomalo and Rettberg, 2018), crime and violence (Allen, 2017), bribes and corruption, and measures to solve these and other problems in order of promoting peace within and through the mining activity.

The promotion of peace and justice at all levels is necessary for all types of economic/industrial activity. Mining can achieve this goal in several ways: by combating corruption and bribery, by disseminating information transparently, by easing conflicts with the local community, by ensuring inclusive and participatory decision-making between government/business/community and guaranteeing the Rule of Law.[2]

The fight against corruption must be a constant in mining regions. A study in Africa has found that mining areas become more corrupt after the opening of mines, even though they do not present such a scenario before the start of exploration. The research also emphasizes that local economic activity is different, regarding corruption, in areas where there is no mining activity, suggesting that mining income encourages and allows local authorities to accept bribes. This scenario also occurs in Brazil (Brasil and Pires, 2017), Australia (Mcclintock and Bell, 2013), as well as in other parts of the world.

In order to promote peace and guarantee justice for all, by avoiding corruption at all levels, miners must have a deep understanding of the regional history, laws, culture, and religions. They also should conduct its operations by local and international laws, with the uppermost standards of ethical practice, developing and maintaining appropriate procedures and protocols regarding the activity (Mcclintock and Bell, 2013). In Brazil, legislation has been improved to prevent, through compliance, new corruption cases involving companies (Brasil, 2013).

One of the useful tools to achieve this goal is the establishment of ombudsmen, a space that enables interaction between the population and institutions (industries, government, etc.) to ensure inclusive access and decision-making participation. Also, the promotion of public hearings facilitates the achievement of this SDG. In this way, it is possible the search for a more peaceful and just society with the collaboration of all the stakeholders.

In the visits to the crushed stone industries, it was found that there was no request for public hearings for any of the enterprises, thus configuring the lack of society involvement in the environmental licensing processes. Brazilian legislation establishes that extractive industries should publish the application for licensing in local media, such as newspapers (Brasil, 1997), so that public hearings may be required. The environmental agency promotes them when it deems necessary, or when requested by a public entity, by the Public Prosecution Service, or by fifty or more citizens (Brasil, 1987). The involvement of society can foster transparency in the disclosure of company data, enabling the attainment of this SDG.

[1] Fishing period forbidden due to fish reproduction.

[2] The Rule of Law exists to guarantee respect for civil liberty, human rights, and fundamental guarantees, through the establishment of legal protection. The rules are also imposed on the political authorities that must be subject to them (Santos, 2011).

Table 2
Actions for the SDG application in mining.

Actions proposed by Selmier II and Newenham-Kahindi (2017)	Reality of the visited crushed stone mines	Application in any kind of mining
Local complexities require local solutions, involving members of local communities	There is no community involvement in educational projects and clarification lectures on the activity	Residents can help the community and industries to adapt to changes by knowing the activity to achieve all the SDG.
Industry-specific guidelines and laws	There are Laws, Decrees, Norms, and Regulations that govern the crushed stone mining sector, in addition to the Code of Mining that covers the entire mining sector.	Mining companies need to follow specific guidelines to frame and implement their efforts to achieve the SDG, based on the particular type of mining.
Transparency in the dissemination of data and information	There was no request for public hearings for any of the industries, compromising the disclosure of data regarding the activity. However, the community has access to environmental studies, made available by the environmental agency.	Transparency in information promotes legitimacy and improvement in business operations, contributing significantly to achieving the SDG in the mining activity.

Source: Authors.

3.17. SDG 17: strengthen the means of implementation and revitalize the global partnership for sustainable development

The keywords used for this goal were “mining” AND "sustainable development goals". The recovered papers discuss the application of the SDG in the mining sector. The last goal is related to the interaction between countries, through partnerships, for the implementation of all other SDG, aiming at to achieve a sustainable future in all dimensions. Mining industries must be committed to environmental issues, caring for responsible access and management of natural resources, implementing environmentally sustainable practices and acting with social responsibility (Vintró et al., 2014).

According to Gallo and Setti (2014), the process of managing territorialized agendas provides support for decision making and for the formulation of policies, programs, and projects that promote sustainable and healthy territories. It also can become a tool to support the monitoring and evaluation of SDG. Selmier II and Newenham-Kahindi (2017) raised three questions about the application of SDG in mining, as described in Table 2. A comparison was made with the reality found in the visited industries and the application to any type mining.

Besides these, other actions also should be considered in the context of the implementation of the SDG: the proper assessment of local geological conditions, technical and legislative factors in the region; the current and future situation of mining within the scope of territorial planning; as well as the exploration of scenarios with or without mining, (Florkowska and Bryt-Nitarska, 2018).

4. Conclusion

The 17 SDG have emerged as guidelines for an action plan aimed at pursuing an environmentally sustainable future, coupled with economic growth and social inclusion. The visits to the crushed stone mining industries and the research in the scientific literature have enabled the realization that, in the context of mining, there are strategies that can lead to the fulfillment of each one of these goals. Through the effort and collaboration between miners, government, and local communities, it is possible to glimpse the potential of the sector to attend the proposed 17 SDG, in a practical way.

It was found that the visited industries contribute to the generation of jobs and income in the region where they are installed (SDG 1, 2 and 8), as well as, they promote improvements to the community regarding the site infrastructure (SDG 9). However, there are shortcomings such as the low incidence of women in the workforce (SDG 5), lack of access facilitation to education for both employees and the community (SDG 4), and the absence of public hearings, which compromises the transparency in data disclosure (SDG 16). Additionally, these industries do not make the environmental restoration of the area, jeopardizing the attainment of the SDG 2, 10, 13 and 15.

The community involvement, both in educational campaigns promoted by the industries, and denouncing the activity development outside the legal parameters can enable favorable scenarios for carrying out effective actions for the benefit of the collective (industries, society, and the environment). Government incentives at the local, regional and global levels can foster social inclusion and social justice.

The pursuit of sustainable development is a challenge for all economic activities and mining is no different. All SDGs are compatible with mining activity. But it is necessary government and society pressure to make this activity fully sustainable within current technological standards, even if there will be a reduction in profit or a cost increase in its products.

Thus, mining companies have an important role to play in promoting inclusive and fair jobs, contributing to the eradication of poverty. They can encourage the dissemination of knowledge about the sector through education, and the disclosure of information and data in a transparent manner. In addition, they can improve the collaboration for using and sharing clean energy and infrastructure, and the mitigation of environmental impacts on soil, water and air. Most of all, mining industries can promote peace in all possible spheres, contributing to the achievement of each one of the SDG.

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